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(71) Applicant: COLGATE-PALMOLIVE COMPANY [US/US]; 300 Park Avenue, New York, NY 10022 (US).

(72) Inventors: JURT, Alfred; Murhubelstr., 2, CH-6234 Triengen (CH). STRAEHLER, Reto; Kehlhofhohe 3, CH-6043 Adligenswil (CH). CHEN, Albert, C.; 14 Vaux Hall Road, East Brunswick, NJ 08816 (US). RUSSELL, Bruce, M.; 30 Flintlock Drive, Howell, NJ 07731 (US). MINTEL, Thomas, E.; 439 Central Avenue, Rahway, NJ 07065 (US). EDWARDS, Mark, S.; 26 Tall Oaks Drive, Hockessin, DE 19707 (US).

(74) Agent: GOLDFINE, Henry, S.; Colgate-Palmolive Company, 909 River Road, P.O. Box 1343, Piscataway, NJ 08855-1343 (US).

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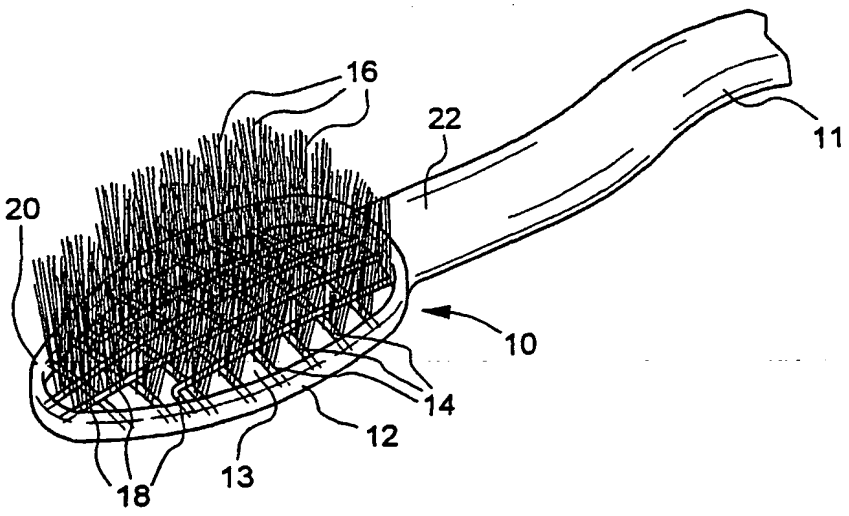
(54) Title: TOOTHBRUSH CONTAINING A RESILIENTLY FLEXIBLE BRISTLE FIELD



(57) Abstract: The present invention relates to a softer toothbrush and method of manufacture thereof, which toothbrush contains a flexibly resilient field of individual bristles with enlarged diameters to provide enhanced cleaning; wherein the brush head has a rigid peripheral fame containing therein an open lattice of base strings from which said field of individual bristles extends.

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Toothbrush Containing a Resiliently Flexible Bristle Field

Field of the Invention

The present invention relates to toothbrushes and methods of manufacture thereof, and more particularly, to toothbrushes and methods of manufacture thereof, which contain a resiliently flexible field of individual bristles, which bristles are of greater diameter than conventional soft toothbrush bristles, while imparting a cushioned, soft impact in use, allowing enhanced cleaning without greater harm to gingival tissue than conventional soft bristles.

Background of the Invention

It is known that toothbrushes, in particular the use of harder bristle toothbrushes, may cause harm to the soft oral tissues within the mouth, especially the gingiva. Such harm may be manifested by general gingival recession and by the associated appearance of three types of localized gingival lesions: (1) erosion of the epithelial surface at the gingival margin or a diffuse border at the gingival-tooth margin, with bleeding or fluid emanation from the eroded area; (2) rupture or fenestration of the surface epithelium in a prominent, otherwise healthy gingival area; and (3) rolling-up of the epithelial surface to leave the underlying tissue exposed. It has been shown that the level of harm can be significantly decreased when a soft toothbrush is used rather than a medium toothbrush. See, M. Pader, Oral Hygiene Products and Practice, Marcel Dekker, Inc., 1988, page 170.

The characterization of a toothbrush as "soft", "medium" or "hard" is directly related to the "softness" of the brush's bristles. The "softness" of bristles of a given material varies with the bristles' diameter and length, which together define the resistance to deformation (e.g. bending) of the bristle filament; wherein, a filament's "softness" increases with increasing diameter and with decreasing bristle length. Typical, modern toothbrushes contain nylon bristles generally about 0.43 inches (11 mm) long, which toothbrushes are classified "soft" when the bristle diameter is about 0.006 inches (0.15 mm) to about 0.007 inches (0.18 mm) or less, "medium" with a diameter of about 0.0080 inches (0.20 mm), and "firm" or "hard" with a diameter of about 0.009 inches (0.23 mm) or more.

The use of such "soft" bristles, while important in minimizing potential harm to the gingiva, will not provide the scrubbing effect to effectively remove plaque, stains and food debris as do larger diameter bristles. Such larger diameter bristles, of 0.008 inches (0.20 mm) or more in diameter, allow additional brushing force to be applied to the teeth, to more effectively loosen and sweep away plaque and food debris, and scrub away stains.

Thus there is a clear need for toothbrushes that provide the gentleness and avoidance of harm to the soft oral tissues of the mouth of lesser diameter, "soft" bristles, while providing the enhanced cleaning of larger diameter, softer bristles.

Brief Summary of the Invention

The present invention encompasses a toothbrush and method of manufacture thereof, which toothbrush has a head with a rigid peripheral frame, said rigid peripheral frame having at least one transverse aperture therethrough, across which aperture or apertures extend a plurality of base strings, which base strings support a field of individual bristles, which strings and bristles are yieldable by bending

and rotating during use. The ability of each individual bristle and supporting base string to yield by bending and rotating during use, especially the transverse rotation of each individual bristle about the longitudinal axis of its supporting base string, provides a reduction in bristle "softness" not possible with typical toothbrushes; wherein, each bristle is secured non-rotatably within the material of the toothbrush head.

Bristle "softness" can be further reduced by using thinner, more flexible, base strings and by placing the base strings in-compression within the rigid peripheral frame, such that the base strings bow or arch outwardly from the plane in which the rigid peripheral frame is disposed. Such outwardly arched base strings exhibit an enhanced ability to absorb a proportion of the brushing force when the toothbrush is applied to the teeth and gums. Unexpectedly, using typical nylon bristles in a toothbrush of the present invention, the bristle "softness" is significantly reduced, enabling larger diameter bristles, i.e. from about 0.008 inches (0.20 mm) to about 0.015 inches (0.38 mm) or more, to be used for more effective cleaning; while, at the same time providing the softness characteristic of "soft" toothbrushes having bristle diameters of 0.006 inches (0.15 mm) to 0.007 inches (0.18 mm) or less.

In a second embodiment of the present invention, the rigid peripheral frame of the toothbrush head contains more than one transverse aperture extending therethrough. The rigid peripheral frame may have two, three, four, five or more, transverse apertures extending therethrough, which apertures may be of equal or non-equal area. Each of which transverse apertures containing therein a plurality of base strings, which plurality of base strings extending across any particular aperture forms a resiliently flexible lattice, from which lattice extends a field of individual bristles. As stated, by varying the degree of compression in which each lattice of base strings is held, the degree that that particular lattice is arched outwardly will increase or decrease, correspondingly effecting the flexibility of the field of bristles, to obtain the desired "softness" thereof.

Manufacture of toothbrush heads of the present invention having a rigid peripheral frame with at least one aperture extending therethrough comprises the steps of: initially, positioning between the two sections of the mold, pre-formed bristle sub-assemblies having a plurality of individual bristle filaments joined to and extending from a base string. Next, injecting the thermoplastic material of construction of the toothbrush frame into the mold forming the rigid, peripheral frame, whereby the ends of the base strings are permanently locked into place in the frame, fixing the sub-assemblies across each aperture within the rigid peripheral frame. Further, as the molten thermoplastic material from which the rigid peripheral frame is formed cools, the rigid peripheral frame will contract, shrinking in diameter such that the base strings extending thereacross will be placed in-compression; whereby, the base strings will arch outwardly from and over the plane in which the rigid peripheral frame is disposed, such that each base string will exhibit an enhanced resilient flexibility.

Alternatively, in the manufacture of toothbrushes of the present invention, the base strings when positioned across each aperture within the rigid peripheral frame may be held thereacross in tension. As the rigid peripheral frame contracts in cooling, the tension within the base strings will be relieved, such that the base strings will not arch outwardly from the plane in which the rigid peripheral frame is disposed; the base strings will remain flat within the rigid peripheral frame.

Brief Description of the Drawings

Fig. 1 is a top perspective view, showing the toothbrush head of the present invention, having one discrete aperture extending through the rigid peripheral frame of the head, with a field of individual bristles extending from four longitudinal base bristle bearing strings and eight

transverse base bristle bearing strings. This toothbrush head is shown with a typical flat bristle trim pattern, in a clear, transparent frame.

Fig. 2 is a perspective view, showing the toothbrush head of Fig. 1, in a clear, transparent frame, containing the open lattice of bristle supports without any bristles attached thereto.

Fig. 3 is a top view of the toothbrush head of Fig. 1.

Fig. 4 is a bottom view of the toothbrush head of Fig. 1.

Fig. 5 is a front end view of the toothbrush head of Fig. 1.

Fig. 6A is a bottom view of an alternative embodiment of the toothbrush head of Fig. 1. having three longitudinal and eight transverse base bristle bearing strings.

Fig. 6B is a bottom view of a third alternative embodiment of the toothbrush head of Fig. 1. having three longitudinal and nine transverse base bristle bearing strings.

Fig. 7 is a bottom view of a fourth alternative embodiment of a toothbrush head of the present invention, similar to that shown in Fig. 1, however, the head has a general trapezoid configuration with rounded ends and has five longitudinal and nine transverse base bristle bearing strings.

Fig. 8 is a bottom view of a fifth alternative embodiment of a toothbrush head of the present invention, similar to that shown in Fig. 1; however, the head has two apertures therethrough, each aperture containing four longitudinal and four transverse base bristle bearing strings.

Detailed Description of the Invention

Referring to the drawings, wherein like reference numerals refer to the same or similar elements among the several figures, and in particular to Fig. 1; wherein there is shown a toothbrush head, 10, in accordance with the present invention, which head is located at one end of an elongated handle, a portion, 11, of which is shown. As shown in Fig. 1, said toothbrush head, 10, has a rigid, peripheral frame, 12, which rigid, peripheral frame defines an opening or aperture, 13, extending therethrough. As shown in Fig. 1, the toothbrush head has an upper face, 20, from which extend a plurality of individual bristles, 16, forming a field of individual bristles. The individual bristles are mounted to a series of longitudinal, 18, and transverse, 14, base strings, which base strings extend across the aperture forming a lattice pattern.

Referring now to Fig. 2, a perspective view of a toothbrush head, 10, of the present invention, shown without any bristles. As shown in Fig. 2, each of the longitudinal, 18, and transverse, 14, base strings which form the lattice is arched outwardly in a vertical direction above the plane defined by the points of joining of the base strings to the rigid, peripheral frame, i.e. the base plane in which the rigid peripheral frame is disposed. The apogee of the lattice is from about 0.0 to 0.040 inches above the base plane.

The field of individual bristles shown in Figs. 1 and 5 is formed in a typical flat toothbrush trim pattern for illustrative purposes only. In the present invention, any conventional toothbrush trim pattern can be used, such as a wave, zig-zag or high-low pattern; wherein the individual bristles will extend from about 0.24 inches (6 mm) to about 0.55 inches (14 mm) from the face, 20, of the toothbrush head, 10.

The cross-section of the monofilament bristles 16, useful in the present invention may be circular, oval, rectangular or polygonal, with a diameter or largest cross-sectional dimension of from about 0.008

inches (0.20 mm) to about 0.015 inches (0.38 mm) or more. The bristles may be from about 0.24 inches (6 mm) to about 0.55 inches (14 mm) in length.

The base strings 14,18, are preferably rectangular or square in cross-section; but may be circular, oval or polygonal, with a diameter or largest cross-sectional dimension of from about 0.015 inches (0.38 mm) to about 0.040 inches (1.02 mm), preferably about 0.030 inches (0.76 mm) or less, in order to provide additional "softness" to the toothbrush in use, i.e. by providing additional resilient flexibility to the field of individual bristle filaments.

The monofilament bristles, 16, and the longitudinal, 18, and transverse, 14, base strings may be made of the same or different polymeric materials, including aliphatic polyamides, aromatic polymides, polyesters, polyolefins, styrenes, fluoropolymers, polyvinylchloride (PVC), polyurethane, polyvinylidene chloride, and polystyrene and styrene copolymers, or combinations thereof. A preferred material is 6,12 nylon; though other nylons may be used, including 4 nylon, 6 nylon, 11 nylon, 12 nylon, 6,6 nylon, 6,10 nylon, 6,14 nylon, 10,10 nylon, 12,12 nylon and other nylon co-polymers. A particularly preferred 6,12 nylon is sold under the tradename TYNEX®, and is manufactured by E.I. DuPont de Nemours and Company of Wilmington, Delaware.

As shown in Fig. 1, toothbrush head, 10, is connected to a neck, 22, which in turn is connected to a conventional toothbrush handle, a portion of which is shown at 11. The rigid peripheral frame, 12, about the head, 10, may be generally oval (Figs. 2, 3, 4, 6A and 6B), trapezoidal (Fig. 7) or rectangular in shape and may preferably be molded or otherwise formed as a single piece integral with the neck, 22, and handle, 11. The peripheral frame, 12, is at least 1/32 of an inch (0.79 mm) in width, preferably at least 1/16 of an inch (1.59 mm) in width, so as to be rigid enough to withstand the forces exerted thereon during use of the toothbrush, without significant distortion thereof. Further, in alternate embodiments of the present invention, wherein

there are two or more apertures extending through the peripheral frame, as shown in Fig. 8, the portion of the peripheral frame separating the apertures should correspondingly be at least 1/32 of an inch (0.79 mm) or greater in width.

The overall toothbrush frame, including the rigid peripheral frame, 12, neck, 22, and handle, 11, may be molded of of a thermoplastic, especially polypropylene, though other plastic materials, such as polyester may be used. As the plastic of the rigid peripheral frame, 12, cools after being formed, it will shrink from about 0.2% if polyester, to about 1.5% if polyproplyene, such that the bristle sub-assembly extending across the aperture or apertures within the rigid peripheral frame, 12, will be placed in-compression and will tend to arch outwardly from the plane within which the rigid peripheral frame is disposed. A suitable polypropylene, with a flexural modulus of 216,000 psi (15,186 kilograms/cm^2) by ASTM test method D790, is available from Huntsman Corporation, Longview, Texas, 75603 under the trade-designation Huntsman Polypropylene P4G3Z-039. Another suitable polypropylene is available from Amoco Polymers, Inc., Alpharetta, Georgia 30202-3914, sold under the trade designation 7635 with a flexural modulus of about 275,000 psi (19,334 kilograms/cm^2). Use of a toothbrush handle of such a 216,000 psi (15,186 kilograms/cm^2) to 275,000 psi (19,334 kilograms/cm^2) material will provide enhanced rigidity to allow the user to better control and manipulate the position of the toothbrush head during brushing.

PCT International Patent Publication WO 99/62371 discloses means to manufacture monofilament bristle subassemblies useful in the present invention comprised of a base string having a plurality of monofilament bristles transversely connected thereto. As disclosed in WO 99/62371, the bristles are arranged substantially parallel to each other in substantially the same plane and placed in contact with the base string. The contacted bristles and base string are then transported under a stationary ultrasonic horn, which delivers sufficient energy to cause either the bristles and/or base string to flow;

such that the bristles and base strings become connected through a flow zone, resulting in the subject monofilament bristle subassemblies.

The manufacture of toothbrushes of the present invention can be facilitated by using known, conventional one-step injection molding processes. Within such a one-step injection molding process, the monofilament bristle subassemblies are positioned in a lattice pattern across the first half of the head portion of the mold, along the parting-line thereof; with the base strings thereof extending through openings or holes in the mold about the interior portion of the rigid peripheral frame, 12. The subassemblies when positioned across the parting line of the mold, are positioned such that the monofilament bristles extending therefrom will fit within a concavity within the second half of the mold when the mold is closed, such that the monofilament bristles will not be impacted and the positioning of the subassemblies will not be effected when the mold is closed prior to injection of the thermoplastic of the toothbrush therein.

When the base strings are fixed through said holes in the interior portion of the rigid peripheral frame, 12, the base strings may or may not be in-tension, as one means of controlling the degree to which the base strings will arch outwardly. Specifically, when the rigid peripheral frame contracts after being molded, if the base strings are not originally in-tension the base strings will be placed in-compression and will arch outwardly from the plane in which the ends of the base strings are held within the rigid peripheral frame, 12. Conversely, if the base strings are originally in-tension when the rigid peripheral frame is molded, as the rigid peripheral frame, 12, cools and contracts the tension will be relieved and the base strings will remain flat within the plane in which the ends of the base strings are held in the rigid peripheral frame. The degree to which the base strings are placed in tension, as well as, the particular modulus of contraction of the material of construction of the rigid peripheral frame, 12, allow control of the degree to which the base strings will arch outwardly.

The ends of the base strings may be thickened, by exposure to a heat source; such that, when the plastic of the toothbrush is injected into the mold, it will flow about the thickened ends of the base strings and more securely anchor the base strings into the toothbrush head, 10. Further, by providing such thickenings at the ends of the base strings, it is easier to secure the base strings within the mold of the rigid peripheral frame, 12, to place the base strings in-tension, is so desired.

In the manufacture of the present invention, it is important that only a single base string extends into the mold through each hole provided therein, to ensure that the base strings fit snuggly within the holes provided and that there is no interference by the base strings with joining of the two halves of the mold. Referring to Figs. 2, 3, and 4, it can be seen that the ends of the two longitudinal, 18, base strings closest to the longitudinal sides of the rigid peripheral frame, 12, and farthest from the handle, 18, are angled as they enter the rigid peripheral frame, 12. This angle is to facilitate the entry of the base strings into a discrete hole in the mold; for if these particular base strings where not angled they would enter the mold at a point identical with the transverse, 14, base strings located immediately adjacent thereto and furthest away from the neck, 18, such that each string would interfering with the entry of the other into their discrete holes.

The base string layouts shown in Figs. 6A, 6B, and 7 are such that the longitudinal base strings, 18, do not intersect with the rigid peripheral frame, 12, anywhere near the transverse base strings, 14; so that no strings need to be angled to avoid intersecting with others at their entry points into the mold, as previously discussed with respect to the embodiments of Figs. 2, 3, and 4. Use of a more rectangular or trapezoidal shape for the rigid peripheral frame, as shown in Fig. 7, is preferred to facilitate having more longitudinal base strings than the embodiments of Figs. 6A and 6B and still avoid intersection of the base strings at the discrete holes therefor about the rigid peripheral mold frame.

Conventional one component injection molds useful in the manufacture of the present invention are available from Machines Boucherie NV, Izegem, Belgium. Which molds can be mounted in typical injection molding machines, such as 300 ton injection molding machines available from Engel Canada, Inc., Guelph, Ontario.

Claims

We claim:

1. A toothbrush comprising:

a handle having a head at one end thereof, which head has a rigid peripheral frame thereabout and a longitudinal axis therethrough, the rigid peripheral frame having at least one transverse aperture extending therethrough;

a plurality of base strings, each string having two ends, each of which is secured to the rigid peripheral frame, whereby each string extends across at least one aperture within the rigid peripheral frame;

each of the base strings having extending therefrom a plurality of polymeric monofilament bristles, whereby the base strings and bristles are yieldable by bending and rotating during use.

2. The toothbrush of claim 1, wherein each of the base strings is arched upwardly over a base plane within a base plane defined by the intersections of each of the ends of each base string and the rigid peripheral frame.

3. The toothbrush of claim 2, wherein the furthest that each base string arches over the base plane is from about 0.0 inches to about 0.04 inches (1.02 mm).

4. The toothbrush of claim 1, wherein the bristle subassemblies are arranged as a lattice formed by the base strings being in a pattern generally parallel and transverse to the longitudinal axis of the head.

5. The toothbrush of claim 1, wherein the monofilament bristles extend from about 0.24 inches (6 mm) to about 0.55 inches (14 mm) over said base strings.

6. The toothbrush of claim 1, wherein the monofilament bristles have a diameter of from about 0.008 inches (0.20 mm) to about 0.015 inches (0.38mm).

7. The toothbrush of claim 1, wherein the lattice of base bristle strings extends at most from about 0.015 inches (0.38 mm) to 0.040 inches (1.02 mm) above the plane within which the rigid peripheral frame is disposed.

8. The toothbrush of claim 1, wherein the cross-section of the monofilament bristles are either circular, oval, rectangular or polygonal.

9. The toothbrush of claim 1, wherein the diameter of the base strings is from about 0.015 inches (0.38 mm) to about 0.040 inches (1.02 mm).

10. The toothbrush of claim 1, wherein the cross-section of the base strings are either rectangular, square, circular, oval or polygonal.

11. The toothbrush of claim 1, wherein the monofilament bristles and base strings may be made of the same or different polymeric materials of either a aliphatic polyamides, a aromatic polymide, a polyester, a polyolefin, a styrene, a fluoropolymer, a polyvinylchloride (PVC), a polyurethane, a polyvinylidene chloride, or a polystyrene and a styrene copolymer, or combinations thereof.

12. The toothbrush of claim 11, wherein the monofilament bristles are nylon.

13. A toothbrush of claim 1, wherein the rigid peripheral frame about the head is be generally oval, trapezoidal or rectangular in shape.

14. A toothbrush of claim 1, wherein the rigid peripheral frame is at least 1/32 of an inch (0.79 mm) in width.

15. The toothbrush of claim 1, wherein there is only one aperture extending transversely through the head thereof.

16. The toothbrush of claim 1, wherein there is more than one aperture extending transversely through the head thereof.

17. A process for making a toothbrush having a head containing a rigid peripheral frame with an aperture therethrough comprising the steps of (1) pre-forming bristle subassemblies by transversely joining a plurality of polymeric monofilaments along a base string having two ends, (2) positioning said bristle subassemblies across the head portion of the parting line of a first section of the toothbrush mold, with the monofilmanents extending away from the first section of the mold toward an open portion within the second section of the toothbrush mold formed to accommodate the monofilaments when the mold is closed; (3) positioning the two ends of each base string to extend into the cavity portion of the mold through holes in the interior of the rigid peripheral frame portion of the mold; (4) securing each base string as positioned by closing the two halves of the mold together; (5) injecting the thermoplastic material of the toothbrush into the mold to permanently secure the base strings therein while forming the toothbrush.

18. A process according to claim 17, wherein the base strings when extended into the cavity portion of the mold are under tension, whereby as the rigid peripheral frame portion of the toothbrush cools after manufacture and contracts the tension will be released.

19. A process according to claim 17, wherein prior to pre-forming the bristle subassemblies the two ends of each base string are heated so as to cause a thickening at each end.

20. A process according to claim 17, wherein the bristle subassemblies are positioned in a generally parallel and transverse pattern to the longitudinal axis of the head.

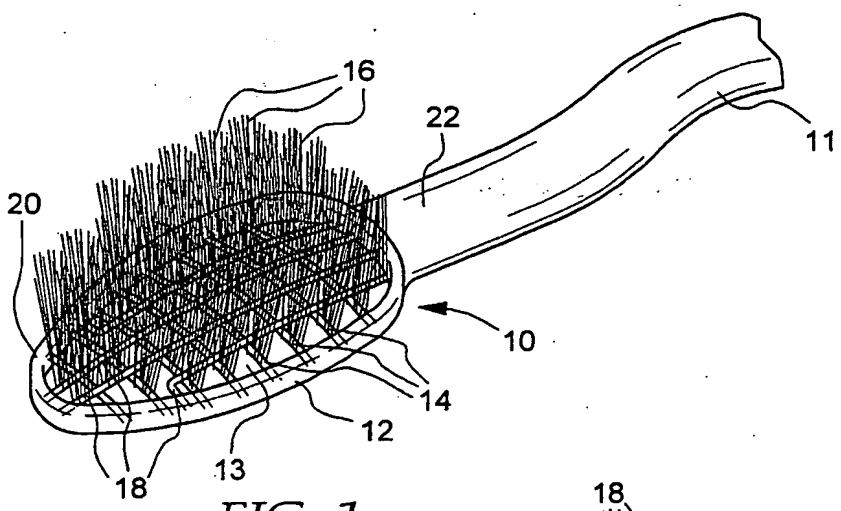

FIG. 1

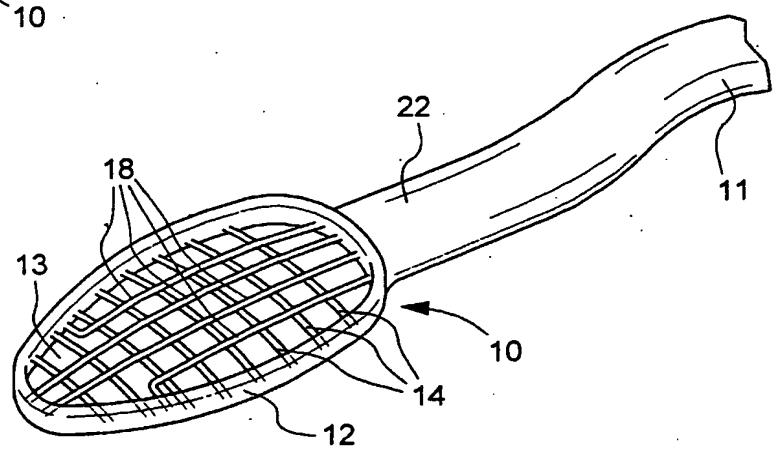

FIG. 2

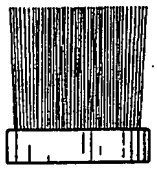

FIG. 5

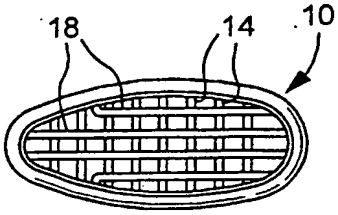

FIG. 3

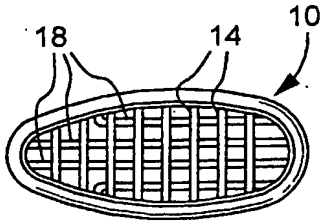

FIG. 4

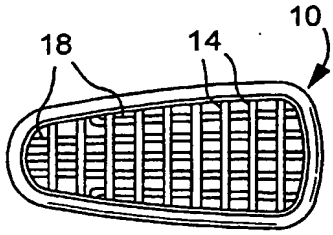

FIG. 7

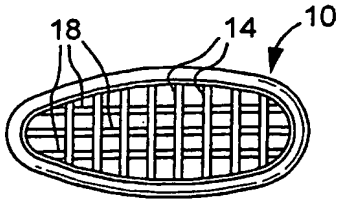

FIG. 6A

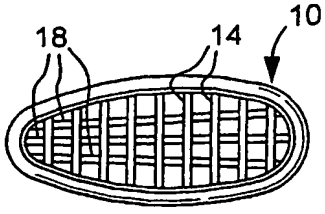

FIG. 6B

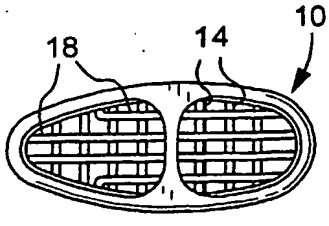

FIG. 8

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(71) Applicant: COLGATE-PALMOLIVE COMPANY [US/US]; 300 Park Avenue, New York, NY 10022 (US).

(72) Inventors: JURT, Alfred; Murhubelstr., 2, CH-6234 Triengen (CH). STRAEHLER, Reto; Kehlhofhohe 3, CH-6043 Adligenswil (CH). CHEN, Albert, C.; 14 Vaux Hall Road, East Brunswick, NJ 08816 (US). RUSSELL, Bruce, M.; 30 Flintlock Drive, Howell, NJ 07731 (US). MINTEL, Thomas, E.; 439 Central Avenue, Rahway, NJ 07065 (US). EDWARDS, Mark, S.; 26 Tall Oaks Drive, Hockessin, DE 19707 (US).

(74) Agent: GOLDFINE, Henry, S.; Colgate-Palmolive Company, 909 River Road, P.O. Box 1343, Piscataway, NJ 08855-1343 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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— *with international search report*

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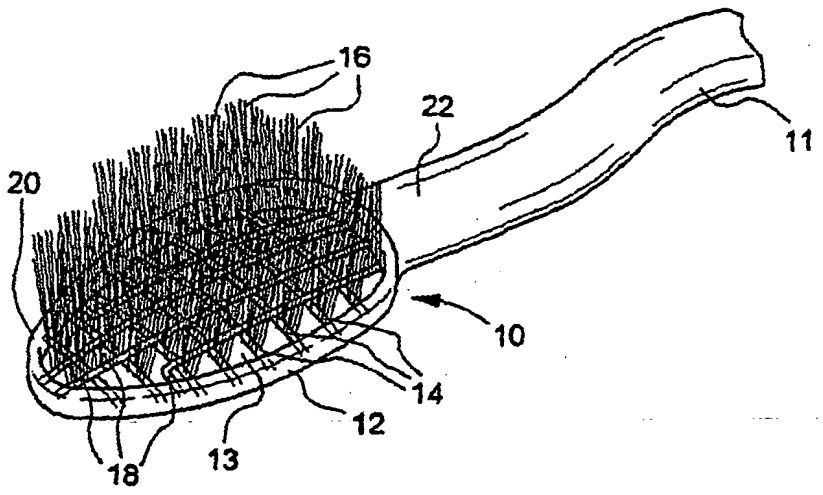
21 March 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TOOTHBRUSH CONTAINING A RESILIENTLY FLEXIBLE BRISTLE FIELD



(57) Abstract: The present invention relates to a softer toothbrush and method of manufacture thereof, which toothbrush contains a flexibly resilient field of individual bristles with enlarged diameters to provide enhanced cleaning; wherein the brush head has a rigid peripheral fame containing therein an open lattice of base strings from which said field of individual bristles extends.

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INTERNATIONAL SEARCH REPORT

Interr onal Application No
PCT/US 01/13210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A46B9/04 A46B3/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A46B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 836 036 A (IVORY BRIAN) 17 November 1998 (1998-11-17) abstract; figures	1-20
A	US 4 500 939 A (GUERET JEAN-LOUIS H) 19 February 1985 (1985-02-19) abstract; figures	1-20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 December 2001	20/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ottesen, R

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INTERNATIONAL SEARCH REPORT

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Interr nal Application No
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